Fundamentals of Water Conservation

Marlborough

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Efficient Rinsing and Cooling Towers

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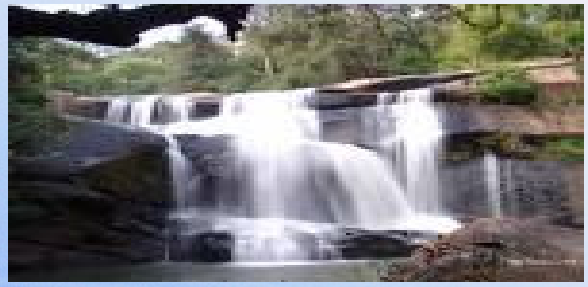
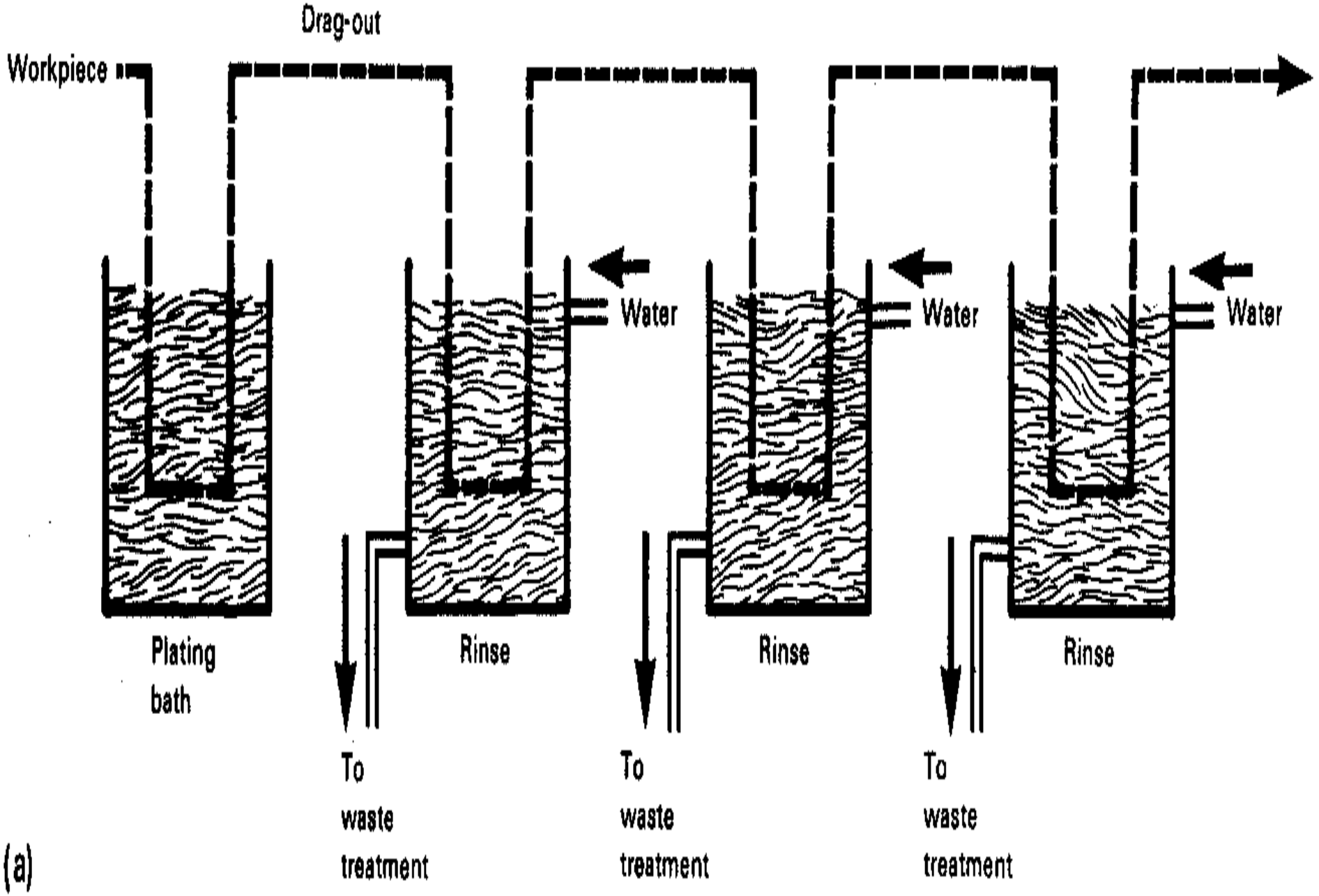
Rinsing: Water Efficiency Practices

- **Install multiple rinse baths to improve rinse efficiency and reduce waste consumption**

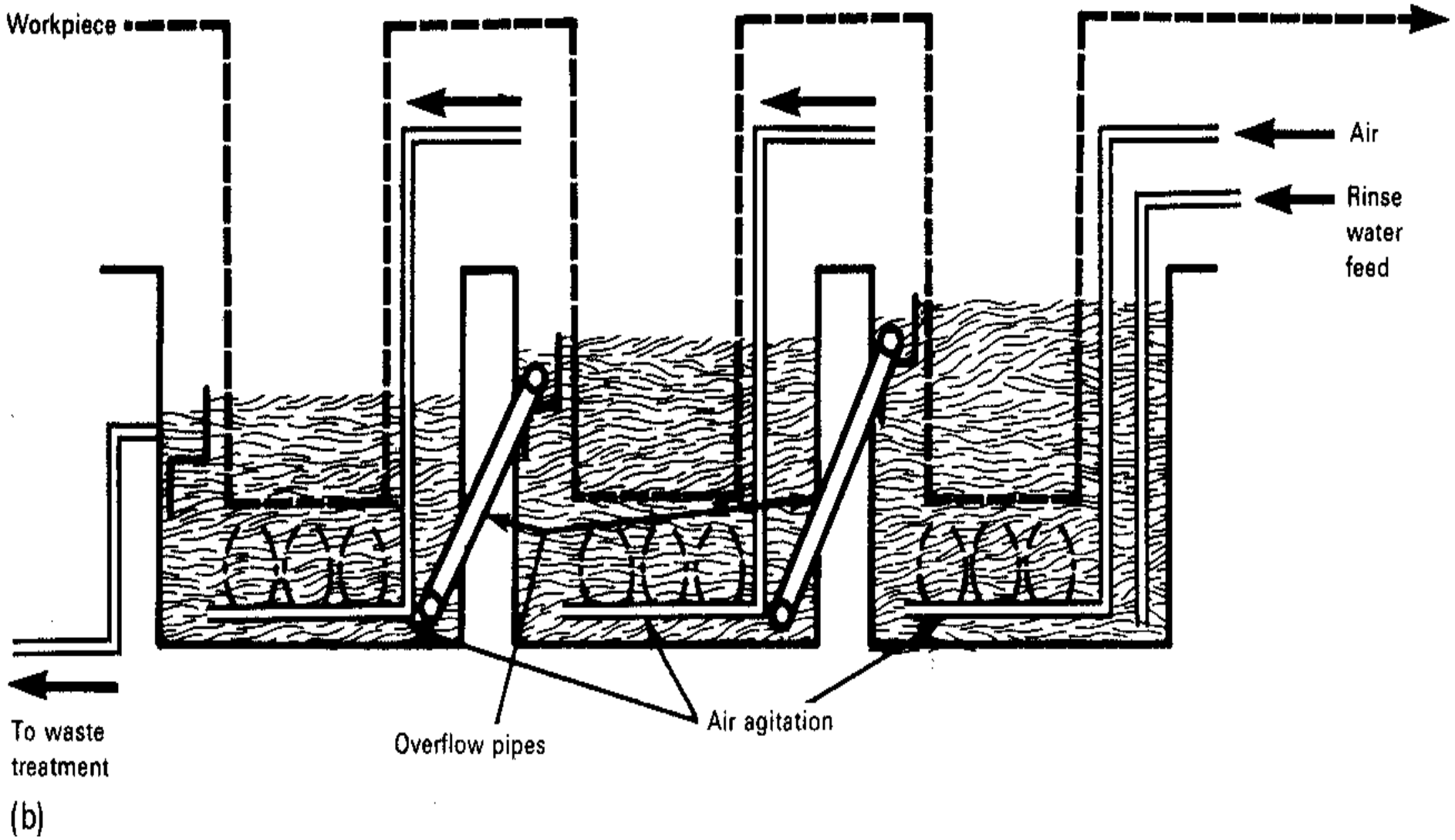


- **Employ reactive rinsing**
- **Rinse water can be reused from a critical rinse to a less critical rinse in the same processing line or between processing lines**

Three-Stage Rinse Systems: (a) Parallel



Three-Stage Rinse Systems: (b) Series With Outboard Arrangement



Rinsing: Water Efficiency Practices (cont.)

- Use agitated rinsing (air blower – not compressed air), ultrasonics, pump circulation, mechanical mixing
- Prevent feed water short-circuiting
- Select the minimum sized tank appropriate for all parts/products.

Rinsing: Water Efficiency Practices

- Switch from continuous to on-demand rinsing (install in-flow meters, control valves and sensors)
- Switch from once-through to closed-loop use
- Measure important parameters (conductivity, TDS, temp, pH, etc) before dumping water
- Prevent drag out from the process tank

Drag-out Reduction

Drag-out = Waste = $$$

- Operate bath formulations at a minimum chemical concentrations

- Maximize bath operating temperature to lower the bath solution's viscosity and surface tension
- Use wetting agents to reduce surface tension.

Drag-out Reduction (cont.)

- Withdraw pieces from the bath slowly
- Increase drip time
- Install drainage boards between process and rinse tanks
- Install rails above process baths to hang workpiece racks for drainage.

Drag-out Reduction (cont.)

- **Use high pressure low-flow spray or fog rinsing nozzles to rinse excess solutions off and into the process baths** (can reduce rinse water use up to 60% compared with counter-current immersion rinsing)
- **Use flow restrictors - installed in the feed line of a tank (work work best in consistent production applications)**
- **Adjust flow rates to the minimum amount required**

Effect of Barrel Design On Dragout Rate (Barrel electroplating)

For small barrels (6”X12”) - 48% deduction in dragout rate (mL/lb of parts)

For large barrels (16”X36”) – 44% reduction

Reference:

Waste Management and Research Center Report

The Chicago Metal Finishers Institute

July 2002

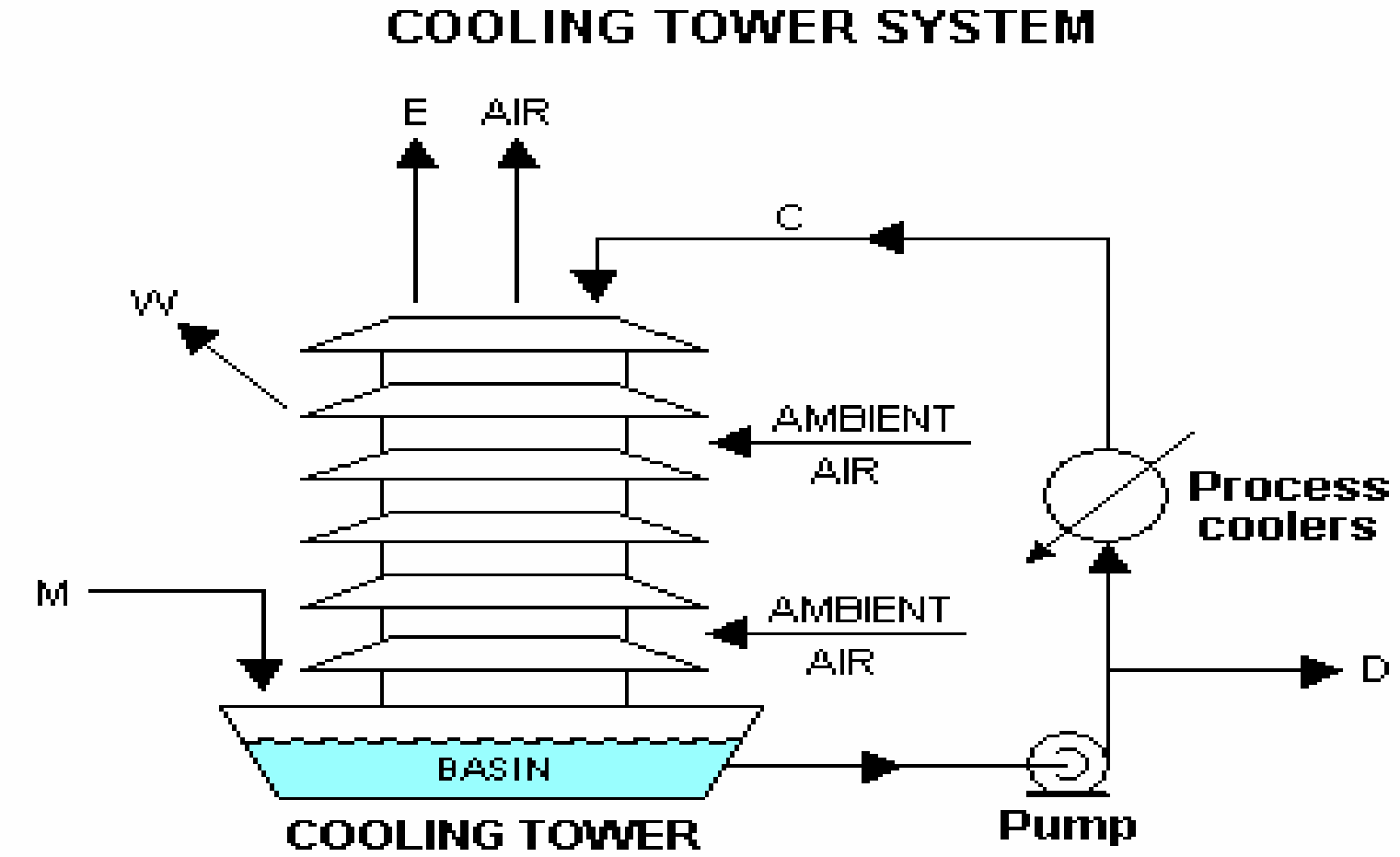
http://www.wmrc.uiuc.edu/main_sections/info_services/library_docs/rr/RR-95.pdf

Tank Cleaning

- Use "dry clean-up" instead of hosing down.
- Use spray washing/rinsing techniques for tank cleaning
- Use a Teflon non-stick surface coating for easy cleaning

Cooling Towers

Water Efficiency Opportunities



C = CIRCULATING COOLING WATER
E = EVAPORATED WATER
W = WINDAGE or DRIFT LOSS
M = MAKEUP WATER
D = DRAWOFF or BLOWDOWN WATER

Cooling Towers

Water Efficiency Opportunities

- Make sure cooling towers are appropriately sized for the cooling load
- Use 2 speed or variable frequency drives on tower fans
- Fan belts should be tightened properly
- Inspect drift losses. If excessive, install drift eliminators or repair existing equipment

Cooling Towers

Water Efficiency Opportunities (cont.)

- Maximize the number of cycles that water is used before bleed-off
- Bleed off only the necessary amount of water
- Install flow meters on make-up and bleed-off lines
- Blowdown is minimized when the concentration ratio increases
- Install automatic controllers that automatically monitor the concentration of dissolved solids and pH

Cooling Towers

Water Efficiency Opportunities (cont.)

- Install an automatic control to shut off the unit when facility is unoccupied or to operate it concurrently with chillers.
- Implement a sidestream filtration system to remove sediment.
- Establish an effective scale, corrosion and bio-fouling protection plan
- Consider adding sulfuric acid to control scale build up

Cooling Towers

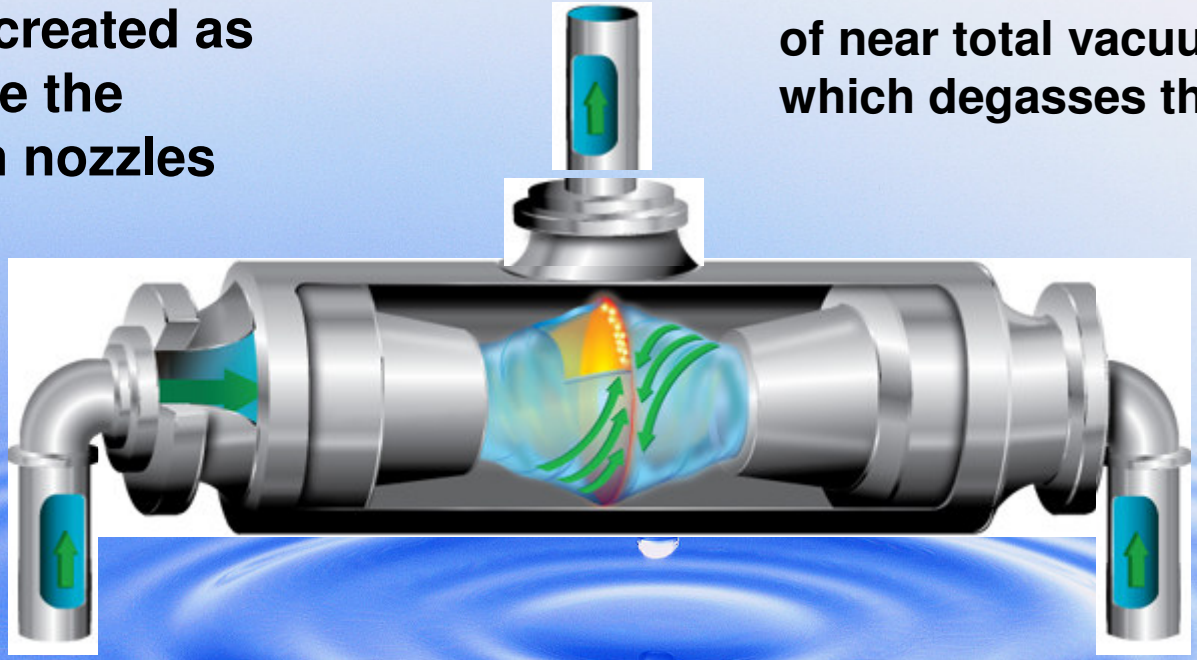
Water Efficiency Opportunities (cont.)

- Replace chemical treatments with non-chemical de-scaling and biological treatments, using non- or less-toxic alternatives when possible (e.g., ozonation)
- Reuse water from other areas in the facility as make-up water
- Some novel treatment technology like water treating magnets and electrostatic field generator can be investigated and validated.

VRTX Technology

opposing water streams created as they leave the precision nozzles

water collides with tremendous kinetic energy and shear. At the core of these streams, a region of near total vacuum is created which degasses the flow.



hydrodynamic cavitation occurs with intense, microscopically localized extremes of temperature (up to 9,000°F), pressure (up to 1,000 atmospheres), and high-energy micro-jets.

Option	Advantages	Disadvantages
Operational Improvements	• Low capital cost. • Low operating cost. • Low maintenance requirements.	• Limited cycles of concentration.
Sulfuric acid treatment	• Low capital cost. • Low operating cost. • High cycles of concentration possible.	• Possible safety hazard. • Possible damage to system if overdosed.
Sidestream filtration	• Reduced possibility of fouling. • Higher operating efficiency. • Reduced maintenance. • Reduced bleed-off.	• Moderately high initial capital cost. • Limited effectiveness for solids removal. • Additional energy costs for pumping.
Ozonation system	• High cycles of concentration possible. • Eliminates chemical treatment.	• High capital investment. • Complex system. • Additional energy costs. • Possible health hazards.
Reuse of water within facility	• Reduces overall facility water consumption.	• Possible requirements for pretreatment (additional chemical and energy costs). • Increased potential for fouling if poor quality water used.

Once-Through (Single Pass) Cooling

Cost-effective options for replacing existing single pass systems:

- **Connect equipment to a recirculating (close loop) cooling system. Installation of a chiller or cooling tower is usually an economical alternative**
- **Reuse once-through cooling water for other water requirements**

Once-Through (Single Pass) Cooling

- Split-system - use heat pumps with remote air-cooled condensers
- Consider replacing water-cooled equipment with air-cooled models
- Packaged air-cooled equipment – install stand-alone air-cooled ice machines and coolers
- If once-through use cannot be avoided, there are still opportunities to improve water efficiency with single pass units.

Once-Through (Single Pass) Cooling (cont.)

Water Efficiency Opportunities:

- Properly insulate piping, chiller or storage tank
- Check entering and exiting water temperatures
- Regularly clean heating coils

Water Efficiency Opportunities (cont.):

- Add an automatic control to shut off entire system when not in use
- Consider reusing single-pass discharge water for other processes (e.g., cooling tower make-up, rinsing, washing, and landscaping).

Discharges that can potentially be reused:

- final rinses from tank cleaning
- cooler flush water, filter backwash
- water from a once-through cooling system
- reverse osmosis reject water

Practices where water may be reused:

- first rinses in wash cycles
- filter backflush
- caustic dilution
- boiler makeup
- equipment cleaning, floor and gutter wash
- cooling tower make-up, rinsing, washing, landscaping (from once-through)